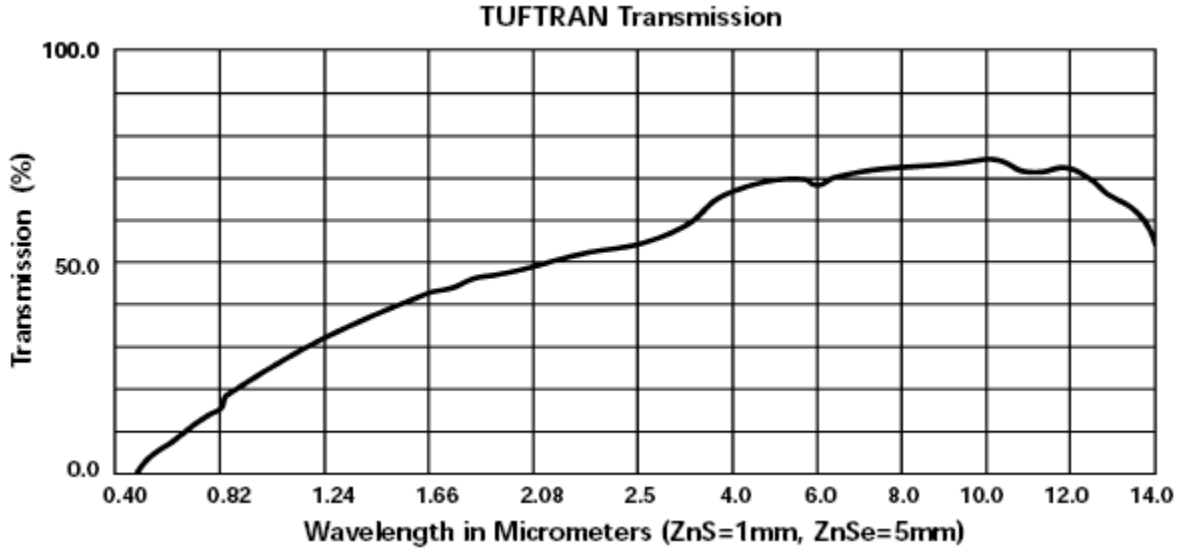
ROHM AND HAAS

TUFTRAN™

Application

Infrared transmissive windows are currently used at the entrance apetures of many airborne reconnaissance or navigation systems. The window material must not significantly decrease the incoming signal or render the signal noisy, and it should be strong enough to resist dust and rain erosion encountered during high speed flight. Zinc Selenide (ZnSe) with its excellent transmission in the infrared is an ideal candidate for this application, however, ZnSe is a “soft” material (hardness = 110 knoop, flexural strength = 8000 psi) which does not effectively resist rain and dust erosion during high speed flight. Zinc Sulfide (ZnS) does not have the superior optical properties of zinc selenide, but it is a “harder” material making it much more capable of withstanding adverse environmental conditions.



TUFTRAN infrared material consists of a polished ZnSe window over which a ZnS layer is chemically vapor deposited. This ≈1 mm thick layer of ZnS protects the ZnSe window and enhances the material’s environmental durability making it better able to resist rain, dust, and dirt. TUFTRAN features the wide band (1-14 µm) imaging characteristics of zinc selenide and the mechanical robustness of zinc sulfide. The resulting material offers high hardness, excellent imaging characteristics, non-hygroscopicity, and ease of fabrication.

When TUFTRAN is fabricated, it relaxes as material is removed. If the ZnS layer is polished first, it should be left convex. This way, when the ZnSe is polished it will relax or bow flat. The method of holding the TUFTRAN blank during polishing greatly influences how convex the ZnS layer is since normal blocking methods keep the blank from relaxing. The preferred method of fabrication is with a single-sided continuous polisher (planetary lap) where the blank is allowed to float in a work holder and is free to relax.

TUFTRAN has been custom ordered in plates up to 24 inches in diameter. Blanks are fabricated according to customer specified surface area and zinc sulfide thickness. A minimum ZnS layer of about 1 mm is recommended.

When ordering TUFTRAN, please call Advanced Materials for a technical discussion.

Mechanical Properties	
Thickness of zinc sulfide	
Prior to grinding	0.100 - 0.125"
Plate glass polished state	0.600" ± 0.005"
Final condition	0.04"
Modulus of rupture (ZnS/ZnSe)	≥7500 psi
Modulus of elasticity (ZnS/ZnSe)	≈8.41 x 106 psi
Hardness of ZnS layer	≥200 knoop

Rain Erosion Resistance

A coating of about 1 mm of ZnS deposited on a ZnSe blank is sufficient to produce a window with rain erosion resistance equivalent to that of pure ZnS without a significant loss in the optical properties of the ZnSe. A sample of TUFTRAN (25 mm diameter x 6 mm thick, 1 mm ZnS, 5 mm ZnSe), coated with COE 2203* rain erosion resistant coating on both sides, was tested for rain erosion resistance at the Royal Aerospace Establishment (RAE) under the following conditions: velocity of 223 m/s (500 MPH), rain field intensity of 25 mm/hour, drop size of 2 mm in diameter, and an impact angle of 75° (normal incidence = 90°) on the ZnS surface. After 20 minutes of erosion time, transmission of the sample dropped an average of 3.0% between 8 and 12 microns. This datum confirms the superior performance against rain erosion.

**COE 2203 is a product of Coherent Optics Europe Limited, Leicester, United Kingdom*

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